The Regulations of Connecticut State Agencies are amended by adding section 22a-153-1, as follows:

(NEW)

Sec. 22a-153-1. General provisions for sources of ionizing radiation.

(a) Definitions. For purposes of sections 22a-153-1 through 22a-153-9, the following definitions shall apply:

(1) "Absorbed dose" means the energy imparted by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the gray (Gy) and the rad.

(2) "Accelerator-produced material" means any material made radioactive by a particle accelerator.

(3) "Act" means chapter 446a of the Connecticut General Statutes.

(4) "Activity" means the rate of disintegration or transformation or decay of radioactive material. The units of activity are the becquerel (Bq) and the curie (Ci).

(5) "Adult" means an individual 18 or more years of age.

(6) "Agreement State" means any State with which the Nuclear Regulatory Commission or the Atomic Energy Commission has entered into an effective agreement under subsection 274b of the Atomic Energy Act of 1954, as amended (42 USC 2021).

(7) "Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, particulates, mists, vapors or gases.

(8) "Airborne radioactivity area" means a room, enclosure or area in which airborne radioactive materials exist in concentrations:

(1) In excess of the derived air concentrations (DACs) specified in Appendix B, Table I of Part D of these regulations; or

(2) To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours.

(9) "As low as is reasonably achievable" or "ALARA" means making every reasonable effort to maintain exposures to radiation as far below the applicable dose limits as is practical, consistent with the purpose for which the licensed or registered activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed or registered sources of radiation in the public interest. For decommissioning purposes, all parameters shall be approved by the Department.

(10) "Background radiation" means radiation from cosmic sources and naturally occurring radioactive materials, including radon, except as a decay product of source or special nuclear material, and including global fallout as it exists in the environment from the testing of nuclear explosive devices. "Background radiation" does not include sources of radiation from radioactive materials regulated by the Agency.

(11) "Becquerel" or "Bq" means the SI unit of activity. One becquerel is equal to 1 disintegration or transformation per second (dps or tps).

(12) "Bioassay" or "radiobioassay" means the determination of kinds, quantities or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct measurement, in vivo counting, or by analysis and evaluation of materials excreted or removed from the human body.

(13) "Brachytherapy" means a method of radiation therapy in which sealed sources are utilized to deliver a radiation dose at a distance of up to a few centimeters, by surface, intracavitary, intraluminal or interstitial application.

(14) "Byproduct material" means:

(1) Any radioactive material, except special nuclear material, yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material; and

(2) The tailings or waste produced by the extraction or concentration of uranium or thorium from ore processed primarily for its source material content, including discrete surface waste resulting from uranium or thorium solution extraction processes. Underground ore bodies depleted by these solution extraction operations do not constitute "byproduct material" within this definition.

(15) "Calendar quarter" means not less than 12 consecutive weeks nor more than 14 consecutive weeks. The first calendar quarter of each year shall begin in January and subsequent calendar quarters shall be so arranged such that no day is included in more than one calendar quarter and no day in any one year is omitted from inclusion within a calendar quarter. The method observed by the licensee or registrant for determining calendar quarters shall only be changed at the beginning of a year.

(16) "Calibration" means the determination of (1) the response or reading of an instrument relative to a series of known radiation values over the range of the instrument, or (2) the strength of a source of radiation relative to a standard.

(17) "CFR" means Code of Federal Regulations.

(18) "Collective dose" means the sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation.

(19) "Commissioner" means the Commissioner of the Connecticut Department of Environmental Protection, or any member of the Department or any local air pollution control official or agency authorized by the commissioner, acting singly or jointly, to whom the commissioner assigns any functions arising under the provisions of these regulations.

(20) "Committed dose equivalent" or "$H_{T,50}$" means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

(21) "Committed effective dose equivalent" or "$H_{E,50}$" is the sum of the products of the weighting factors (w_T) applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues ($H_{E,50} = \Sigma w_T H_{T,50}$).

(22) "Critical Group" means the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.

(23) "Curie" or "Ci" means a unit of quantity of activity. One curie is that quantity of radioactive material which decays at the rate of 3.7E+10 disintegrations or transformations per second (dps or tps).

(24) "Deep dose equivalent" or "H_d", when applied to external whole body exposure, means the dose equivalent at a tissue depth of one centimeter (1000 mg/cm^2).

(25) "Department" means the Connecticut Department of Environmental Protection.

(26) "Department of Energy" means the Department of Energy established by Public Law 95-91, August 4, 1977, 42 U.S.C. 7101 et seq., to the extent that the Department exercises functions formerly vested in the Atomic Energy Commission, its Chairman, members, officers and components and transferred to the Energy Research and Development Administration and to the Administrator thereof pursuant to sections 104(b), (c) and (d) of the Energy Reorganization Act of 1974 (Public Law 93-438, October 11, 1974, 42 U.S.C. 5814, effective January 19, 1975) and re-transferred to the Secretary of Energy pursuant to section 301(a) of the Department of Energy Organization Act (Public Law 95-91, August 4, 1977, 42 U.S.C. 7151, effective October 1, 1977.)

(27) "Depleted uranium" or "DU" means the source material uranium in which the isotope uranium-235 is less than 0.711 weight percent of the total uranium present. Depleted uranium does not include special nuclear material.

(28) "Dose" or "radiation dose" is a generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, total organ dose equivalent or total effective dose equivalent. For purposes of these regulations, "radiation dose" is an equivalent term.

(29) "Dose equivalent" or "H_T" means the product of the absorbed dose in tissue, quality factor and all other necessary modifying factors at the location of interest. The units of dose equivalent are the sievert (Sv) and rem.

(30) "Dose limits" or "limits" means the permissible upper bounds of radiation doses established in accordance with these regulations.

(31) "Effective dose equivalent" or "H_E" means the sum of the products of the dose equivalent to each organ or tissue (H_T) and the weighting factor (w_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \Sigma w_T H_T$).

"Embryo/fetus" means the developing human organism from conception until the time of birth.

(32) "Entrance or access point" means any opening through which an individual or extremity of an individual could gain access to radiation areas or to licensed or registered radioactive materials. This includes entry or exit portals of sufficient size to permit human entry, irrespective of their intended use.

(33) "Exposure" means being exposed to ionizing radiation or to radioactive material.

(34) "Exposure" means the quotient of dQ by dm where dQ is the absolute value of the total charge of the ions of one sign produced in air when all the electrons (negatrons and positrons) liberated by photons in a volume element of air having mass "dm" are completely stopped in air. The SI unit of exposure is the coulomb per kilogram (C/kg).

(35) "Exposure rate" means the exposure per unit of time, expressed in units of roentgen per minute or milliroentgen per hour.

(36) "External dose" means that portion of the dose equivalent received from any source of radiation outside the body.

(37) "Extremity" means hand, elbow, arm below the elbow, foot, knee and leg below the knee.

(38) "Former Atomic Energy Commission or Nuclear Regulatory Commission licensed facilities" means nuclear reactors, nuclear fuel reprocessing plants, uranium enrichment plants, or critical mass experimental facilities where Atomic Energy Commission or Nuclear Regulatory Commission licenses have been terminated.

(39) "Generally applicable environmental radiation standards" means standards issued by the United States Environmental Protection Agency under the authority of the Atomic Energy Act of 1954, as amended, that impose limits on radiation exposures or levels, or concentrations or quantities of radioactive material, in the general environment outside the boundaries of locations under the control of persons possessing or using radioactive material.

(40) "Gray" or "Gy" means the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rad).

(41) "Hazardous waste" means those wastes designated as hazardous by the Environmental Protection Agency regulations in 40 CFR Part 261.

(42) "Healing arts" means "the practice of healing arts" as defined in section 20-1 of the Connecticut General Statutes.

(43) "High radiation area" means an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 1 mSv (0.1 rem) in 1 hour at 30 centimeters from any source of radiation or from any surface that the radiation penetrates.

(44) "Human use" means the internal or external administration of radiation or radioactive material to human beings.

(45) "Individual" means any human being.

(46) "Individual monitoring" means the assessment of:

(1) Dose equivalent by the use of either individual monitoring devices or survey data; or

(2) Committed effective dose equivalent by either bioassay or determination of the time-weighted air concentrations to which an individual has been exposed, that is, DAC-hours.

(47) "Individual monitoring devices" or "personnel monitoring equipment" means devices designed to be worn by a single individual for the assessment of dose equivalent. For purposes of these regulations, "personnel dosimeter" and "dosimeter" are equivalent terms. Individual monitoring devices include, but are not limited to, film badges, thermoluminescent dosimeters (TLDs), pocket ionization chambers and personal air sampling devices.

(48) "Inspection" means an official examination or observation including, but not limited to, tests, surveys, and monitoring to determine compliance with rules, regulations, orders, requirements and conditions of the Agency.

(49) "Instrument traceability" means, for ionizing radiation measurements, the ability to show that an instrument has been calibrated at specified time intervals using a national standard or a transfer standard. If a transfer standard is used, the calibration must be at a laboratory accredited by a program which requires continuing participation in measurement quality assurance with the National Institute of Standards and Technology or other equivalent national or international program.

(50) "Interlock" means a device, electrical or mechanical, that either prevents activation of a control until a preliminary condition has been met or prevents hazardous operation.

(51) "Internal dose" means that portion of the dose equivalent received from radioactive material taken into the body.

(52) "Lens dose equivalent" means the external dose equivalent to the lens of the eye at a tissue depth of 0.3 centimeter (300 mg/cm^2).

(53) "License" means a license issued by the Agency pursuant to regulations adopted under the Act "Licensed or registered material" means radioactive material received, possessed, used, transferred or disposed of under a general or specific license or registration issued by the Agency.

(54) "Licensee" means any person who is licensed by the Department in accordance with the Act.

(55) "Licensing State" means any State with regulations equivalent to the Suggested State Regulations for Control of Radiation relating to, and an effective program for, the regulatory control of NARM and which has been granted final designation by the Conference of Radiation Control Program Directors, Inc.

(56) "Lost or missing source of radiation" means licensed or registered source of radiation whose location is unknown. This definition includes, but is not limited to, radioactive material that has been shipped but has not reached its destination and whose location cannot be readily traced in the transportation system.

(57) "Major processor" means a user processing, handling, or manufacturing radioactive material exceeding Type A quantities as unsealed sources or material, or exceeding four times Type B quantities as sealed sources, but does not include nuclear medicine programs, universities, industrial radiographers or small industrial programs.

(58) "Member of the public" means an individual except when that individual is receiving an occupational dose.

(59) "Minor" means an individual less than 18 years of age.

(60) "Monitoring," "radiation monitoring" or "radiation protection monitoring" means the measurement of radiation, radioactive material concentrations, surface area activities or quantities of radioactive material and the use of the results of these measurements to evaluate potential exposures and doses.

(61) "NARM" means any naturally occurring or accelerator-produced radioactive material. It does not include byproduct, source or special nuclear material.

(62) "Natural radioactivity" means radioactivity of naturally occurring nuclides.

(63) "NIOSH" means the National Institute for Occupational Safety and Health.

(64) "Nuclear Regulatory Commission" or "NRC" means the Nuclear Regulatory Commission or its duly authorized representatives.

(65) "Occupational dose" means the dose received by an individual in the course of employment in which the individual's assigned duties for the licensee or registrant involve exposure to sources of radiation, whether or not the sources of radiation are in the possession of the licensee, registrant or other person. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research programs or as a member of the public.

(66) "Package" means the packaging together with its radioactive contents as presented for transport.

(67) "Particle accelerator" or "accelerator" means any machine capable of accelerating electrons, protons, deuterons or other charged particles in a vacuum and of discharging the resultant particulate or other radiation into a medium at energies usually in excess of 1 MeV, excluding the following: an orthovoltage x-ray machine, a diagnostic x-ray machine, a therapeutic x-ray machine and an electron microscope.

(68) "Person" means "person" as defined in section 22a-151 of the Connecticut General Statutes.

(69) "Pharmacist" means "pharmacist" as defined in section 20-571 of the Connecticut General Statutes.

(70) "Physician" means "physician" as defined in section 20-13a of the Connecticut General Statutes.

(71) "Protective apron" means an apron made of radiation-attenuating materials used to reduce exposure to radiation.

(72) "Public dose" means the dose received by a member of the public from sources of radiation from licensed or registered operations. Public dose does not include occupational dose, a dose received from background radiation, a dose received as a patient from medical practices or a dose received from voluntary participation in medical research programs.

(73) "Pyrophoric material" means any liquid that ignites spontaneously in dry or moist air at or below 130 degrees F (54.4 degrees C) or any solid material, other than one classed as an explosive, which under normal conditions is liable to cause fires through friction, retained heat from manufacturing or processing, or which can be ignited readily and, when ignited, burns so vigorously and persistently as to create a serious transportation, handling or disposal hazard. Pyrophoric material includes spontaneously combustible and water-reactive materials.

(74) "Qualified expert" means an individual having the knowledge and training to measure ionizing radiation, to evaluate safety techniques and to advise regarding radiation protection needs, including, but not limited to: individuals certified in the appropriate field by a specialty board with a certification process recognized by the Commissioner; an "authorized medical physicist" pursuant to 10 CFR 35.51; or those having equivalent qualifications. With reference to the calibration of radiation therapy equipment, an individual having, in addition to the above qualifications, training and experience in the clinical applications of radiation physics to radiation therapy, including, but not limited to: individuals certified in radiological physics by a specialty board with a certification process recognized by the Commissioner; or those having equivalent qualifications.

(75) "Quality factor" or "Q" means the modifying factor listed in Tables I and II of this section that is used to derive dose equivalent from absorbed dose.

(76) "Rad" means the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 erg per gram or 0.01 joule per kilogram (0.01 gray).

(77) "Radiation" or "ionizing radiation" means alpha particles, beta particles, gamma rays, x rays, neutrons, high-speed electrons, high-speed protons, and other particles capable of directly or indirectly producing ions. Radiation does not include non-ionizing radiation such as radiowaves or microwaves, visible, infrared or ultraviolet light.

(78) "Radiation area" means any area, accessible to individuals in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.05 mSv (0.005 rem) in 1 hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates.

(79) "Radiation machine" means any device capable of producing radiation except those devices with radioactive material as the only source of radiation.

(80) "Radiation safety officer" means an individual who has the knowledge and responsibility to apply appropriate radiation protection regulations.

(81) "Radioactive material" means any solid, liquid or gas that emits radiation spontaneously.

(82) "Radioactivity" means the transformation of unstable atomic nuclei by the emission of radiation.

(83) "Registrant" means any person who holds a valid registration. "Registration" means "registration" as defined in Section 22a-151 of the Connecticut General Statutes.

(84) "Regulations of the Department of Transportation" means the regulations in 49 CFR Parts 100-189.

(85) "Rem" means the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 Sv).

(86) "Research and development" means

(1) Theoretical analysis, exploration or experimentation; or

(2) The extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials and processes. Research and development does not include the internal or external administration of radiation or radioactive material to human beings.

(87) "Restricted area" means an area, access to which is limited by the licensee or registrant for the purpose of protecting individuals against undue risks from exposure to sources of radiation. Restricted area does not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area.

(88) "Roentgen" or "R" means the special unit of exposure. One roentgen equals 2.58E-4 coulombs per kilogram of air.

(89) "Sealed source" means any radioactive material that is encased in a capsule designed to prevent leakage or escape of the radioactive material.

(90) "Shallow dose equivalent" or "H_s", as applied to the external exposure of the skin or an extremity, means the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm^2) averaged over an area of 10 square centimeters.

(91) "SI" means the abbreviation for the International System of Units.

(92) "Sievert" means the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor (1 Sv = 100 rem).

(93) "Source material" means:

(1) Uranium or thorium, or any combination thereof, in any physical or chemical form; or

(2) Ores that contain by weight one-twentieth of 1 percent (0.05 percent) or more of uranium, thorium or any combination of uranium and thorium. Source material does not include special nuclear material.

(94) "Source material milling" means any activity that results in the production of byproduct material as defined by definition (2) of byproduct material in this subsection.

(95) "Source of radiation" means any radioactive material or any device or equipment emitting, or capable of producing, radiation.

(96) "Source traceability" or "traceable to a national standard" means the ability to show that a radioactive source has been calibrated either by the national standards laboratory of the National Institute of Standards and Technology or by a laboratory which participates in a continuing measurement quality assurance program with National Institute of Standards and Technology or other equivalent national or international program.

(97) "Special form radioactive material" means radioactive material that satisfies the following conditions:

(1) It is either a single solid piece or is contained in a sealed capsule that can be opened only by destroying the capsule;

(2) The piece or capsule has at least one dimension not less than 5 millimeters (0.2 inch); and

(3) It satisfies the test requirements specified by the Nuclear Regulatory Commission.

A special form encapsulation designed in accordance with the Nuclear Regulatory Commission requirements in effect on June 30, 1983, and constructed prior to July 1, 1985, may continue to be used. A special form encapsulation either designed or constructed after June 30, 1985, must meet requirements of this definition applicable at the time of its design or construction.

(98) "Special nuclear material" means:

(1) Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material that the Nuclear Regulatory Commission, pursuant to the provisions of section 51 of the Atomic Energy Act of 1954, as amended, determines to be special nuclear material, but does not include source material; or

(2) Any material artificially enriched by any of the foregoing but does not include source material.

(99) "Special nuclear material in quantities not sufficient to form a critical mass" means the sum of the ratios of uranium-235 (U-235); uranium-233 (U-233) or plutonium (Pu) is equal to or less than one when determined according to the following formula:

$$\frac{\text{U-235 (grams)}}{350} + \frac{\text{U-233 (grams)}}{200} + \frac{\text{Pu (grams)}}{200} \leq 1$$

(100) "Survey" means an evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal or presence of sources of radiation. When appropriate, such

evaluation includes, but is not limited to tests, physical examinations and measurements of levels of radiation or concentrations of radioactive material present.

(101) "Test" means the process of verifying compliance with an applicable regulation.

(102) "Total effective dose equivalent" or "TEDE" means the sum of the deep dose equivalent for external exposures and the committed effective dose equivalent for internal exposures.

(103) "Total organ dose equivalent" or "TODE" means the sum of the deep dose equivalent and the committed dose equivalent to the organ receiving the highest dose as described in Sec. 22a-153-2(n)(7)(A)(vi) of these regulations.

(104) "Unrefined and unprocessed ore" means ore in its natural form prior to any processing, such as grinding, roasting, beneficiating or refining.

(105) "Unrestricted area" or "uncontrolled area" means an area, access to which is neither limited nor controlled by the licensee or registrant for the purposes of limiting exposure to radiation.
"Waste" or "low-level waste" means radioactive waste that (1) is neither high-level waste nor transuranic waste, nor spent nuclear fuel, nor by-product material, as defined in Section 11e(2) of the Atomic Energy Act of 1954, as amended; and (2) is classified by the federal government as low-level waste, consistent with existing law, but does not include waste generated as a result of atomic energy defense activities of the federal government, as defined in P.L. 96-573, or federal research and development activities.

(106) "Waste handling licensees" mean persons licensed to receive and store radioactive wastes prior to disposal and/or persons licensed to dispose of radioactive waste.

(107) "Week" means seven consecutive days starting on Sunday.

(108) "Whole body" means, for purposes of external exposure, head, trunk including male gonads, arms above the elbow or legs above the knee.

(109) "Worker" means an individual engaged in work under a license or registration issued by the Agency and controlled by a licensee or registrant, but does not include the licensee or registrant.

(110) "Working level" or "WL" means any combination of short-lived radon daughters in one liter of air that will result in the ultimate emission of 1.3E+5 MeV of potential alpha particle energy. The short-lived radon daughters of radon-222 are polonium-218, lead-214, bismuth-214 and polonium-214; and those of radon-220 are polonium-216, lead-212, bismuth-212 and polonium-212.

(111) "Working level month" or "WLM" means an exposure to one working level for 170 hours.

(112) "Year" means the twelve-month period of time used to determine compliance with the provisions of these regulations. The licensee or registrant may change the starting date of the year used to determine compliance by the licensee or registrant provided that the change is made at the beginning of the year and that no day is omitted or duplicated in consecutive years.

(b) Applicability.

(1) Except as otherwise specifically provided, sections 22a-153-1 through 22a-153-9 of the Regulations of Connecticut State Agencies apply to all persons who receive, possess, use, transfer, own or acquire any source of radiation.

(c) Records and reports.

(1) Each licensee and registrant shall make and maintain records showing the receipt, transfer and disposal of all sources of radiation, and any other records necessary to determine compliance with sections 22a-153-1 through 22a-153-9 of the Regulations of Connecticut State Agencies.

(2) Copies of all records to determine compliance with the requirements of sections 22a-153-1 through 22a-153-9 of the Regulations of Connecticut State Agencies shall be made available to the Commissioner to inspect and copy upon request.

(d) Inspections.

Each licensee and registrant shall, at all reasonable times, allow the Commissioner opportunity to inspect sources of radiation and the premises and facilities wherein such sources of radiation are used or stored.

(e) Tests.

Each licensee and registrant shall perform, upon instructions from the Commissioner, or shall permit the Commissioner to perform, such reasonable tests as the Commissioner deems appropriate or necessary including, but not limited to, tests of:

(A) Sources of radiation;

(B) Facilities wherein sources of radiation are used or stored;

(C) Radiation detection and monitoring instruments; and

(D) Other equipment and devices used in connection with utilization or storage of licensed or registered sources of radiation.

(f) Enforcement and prohibitions.

(1) The Commissioner may, by regulation, permit or order, impose upon any licensee or registrant such requirements in addition to those established in sections 22a-153-1 through 22a-153-9 of the Regulations of Connecticut State Agencies, including impoundment of sources of radiation, as it deems appropriate or necessary to minimize danger to public health and safety or property.

(2) The following uses are prohibited:

(A) Use of a hand-held fluoroscopic screen with x-ray equipment unless it has been listed in the Registry of Sealed Source and Devices or accepted for certification by the Food and Drug Administration, Center for Devices and Radiological Health; and

(B) Use of a shoe-fitting fluoroscopic device.

(g) Units of Exposure and Dose.

(1) As used in these regulations the unit of exposure shall be the coulomb per kilogram (C/kg) of air, and one roentgen shall be equal to 2.58E-4 coulomb per kilogram of air at STP.

(2) Except as provided in subdivision (4) of this subsection, for the purposes of sections 22a-153-1 through 22a-153-9 of the Regulations of Connecticut State Agencies, the units of dose shall be the following:

(A) Gray (Gy) is the SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rad);

(B) Rad is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 erg per gram or 0.01 joule per kilogram (0.01 Gy);

(C) Rem is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 Sv); and

(D) Sievert is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor (1 Sv = 100 rem).

(3) Except as provided in subdivision (4) of this subsection, for the purposes of sections 22a153-1 through 22a-153-9 of the Regulations of Connecticut State Agencies, the quality factors for converting absorbed dose to dose equivalent shall be as indicated in Table I.

TABLE I
QUALITY FACTORS AND ABSORBED DOSE EQUIVALENCIES

Type of Radiation	Quality Factor (Q)	Absorbed Dose Equal to a Unit Dose Equivalent[a/]
X, gamma, or beta radiation and high-speed electrons	1	1
Alpha particles, multiple-charged particles, fission fragments and heavy particles of unknown charge	20	0.05
Neutrons of unknown energy	10	0.1

High-energy protons	10	0.1

[a/] Absorbed dose in gray equal to 1 Sv or the absorbed dose in rad equal to 1 rem.

(4) For the purposes of sections 22a-153-1 through 22a-153-9 of the Regulations of Connecticut State Agencies, a licensee or registrant may measure the neutron fluence rate rather than determine the neutron dose equivalent rate in sievert per hour or rem per hour according to one of the following:

(A) 0.01 Sv (1 rem) of neutron radiation of unknown energies may be assumed to result from a total fluence of 25 million neutrons per square centimeter incident upon the body; or

(B) If sufficient information exists to estimate the approximate energy distribution of the neutrons, the licensee or registrant may use the fluence rate per unit dose equivalent or the appropriate Q value from Table II to convert a measured tissue dose in gray or rad to dose equivalent in sievert or rem.

TABLE II

MEAN QUALITY FACTORS, Q, AND FLUENCE PER UNIT DOSE EQUIVALENT FOR MONOENERGETIC NEUTRONS

Neutron Energy (MeV)	Quality Factor[a/] (Q)	Fluence per Unit Dose Equivalent[b/] (Neutrons cm^{-2} rem^{-1})	Fluence per Unit Dose Equivalent[b/] (Neutrons cm^{-2} Sv^{-1})
(thermal)			
2.5E-8	2	980E+6	980E+8
1E-7	2	980E+6	980E+8
1E-6	2	810E+6	810E+8
1E-5	2	810E+6	810E+8
1E-4	2	840E+6	840E+8
1E-3	2	980E+6	980E+8
1E-2	2.5	1010E+6	1010E+8
1E-1	7.5	170E+6	170E+8
5E-1	11	39E+6	39E+8
1	11	27E+6	27E+8
2.5	9	29E+6	29E+8
5	8	23E+6	23E+8
7	7	24E+6	24E+8
10	6.5	24E+6	24E+8
14	7.5	17E+6	17E+8
20	8	16E+6	16E+8
40	7	14E+6	14E+8
60	5.5	16E+6	16E+8
1E+2	4	20E+6	20E+8
2E+2	3.5	19E+6	19E+8
3E+2	3.5	16E+6	16E+8

4E+2	3.5	14E+6	14E+8

[a/] *Value of quality factor (Q) at the point where the dose equivalent is maximum in a 30-centimeter diameter cylinder tissue-equivalent phantom.*

[b/] *Monoenergetic neutrons incident normally on a 30-centimeter diameter cylinder tissue-equivalent phantom.*

(h) **Units of Activity.** For the purposes of sections 22a-153-1 through 22a-153-9 of the Regulations of Connecticut State Agencies, activity shall be expressed in the SI unit of becquerel (Bq) or in the special unit of curie (Ci), or their multiples, or disintegrations or transformations per unit of time, where:

(1) One becquerel (Bq) = 1 disintegration or transformation per second (dps or tps); and

(2) One curie (Ci) = 3.7E+10 disintegrations or transformations per second (dps or tps) =3.7E+10 becquerel (Bq) = 2.22E+12 disintegrations or transformations per minute (dpm or tpm).

Statement of Purpose: This section establishes general requirements to regulate the use of ionizing radiation in the state.